to that caused by the explosion of a high-powered shell. The air surrounding it for a considerable elevation above the ground was immediately filled with dust and débris which, at a distance, appeared like dense smoke from burning oil.

After the storm had been in progress for about 20 minutes it stopped its progressive movement for five minutes. Until it resumed its northeastward course the writer thought it had turned to the northwestward and was moving directly away in the line of vision. Its location at this time was over a large dairy, where one person was killed and one fatally injured and where 20 others were injured. The loss at the dairy from the destruction of buildings, motor trucks, automobiles, and livestock was estimated at $100,000. The funnel cloud rose and descended twice during the stationary period, causing the less severely injured persons at the dairy to think that a second tornado followed closely behind the first.

After the storm resumed its northeastward course it passed over several suburban communities northwest and north of Miami, wrecking many residences, killing or fatally injuring three persons, and injuring many others. Several persons escaped injury and probable death by deserting their automobiles and fleeing. The automobiles were destroyed, some of them being picked up and carried for a considerable distance through the air.

By the time the storm had reached a position directly north of Miami the funnel cloud had increased greatly in diameter and it was soon afterwards obliterated by heavy rain between Miami and the path of the storm. No serious damage was done after this time, and the tornado formation apparently dissipated over the extreme northern part of Biscayne Bay. In the eastern end of the path prostrated poles lay with their tops toward the southwest, showing the effects of the whirling motion.

The path of the storm averaged less than 100 yards in width, and many buildings and trees immediately outside of it were uninjured. Buildings left standing in the path showed where the cloud rose from the ground.

The tornado was preceded by a heavy fall of hail, which was confined principally to the tornado path. In some localities the ground was completely covered, and hail stones were reported as large as a baseball or a man's fist. Many were measured that were 3 inches in diameter. Hailstones perforated the tops of automobiles and damaged the roofs of some houses.

The instruments at the Weather Bureau station at Miami were not affected by the storm. Light southeast winds prevailed at the station during the forenoon of the 5th and until after the tornado had disappeared. As the tornado was carried along in a southwest current, it is evident that it occurred along the wind-shift line of the general disturbance. The pressure at Miami fell gradually until shortly after 2 p. m., when the wind-shift line passed over the station, attended by a thunderstorm with characteristic rise of pressure and a decided increase in wind force. The maximum velocity recorded was 24 miles per hour, from the west, at 2:20 p. m. This was after the tornado had disappeared. The slow movement of the wind-shift line accounts for the slow progress of the tornado, which required approximately one hour to move the 12 miles from Hialeah to the northern part of Biscayne Bay. There were no fluctuations of pressure at the Weather Bureau station during the progress of the tornado.

The storm caused the death of five persons and the destruction of much property. About 35 persons were injured and received treatment in local hospitals, while others, less severely injured, were treated in private dwellings. The estimated property loss was between $200,000 and $300,000.

OCEAN TEMPERATURES ACROSS THE EQUATOR

By W. J. HUMPHREYS

Everyone is accustomed to the well-known and obviously reasonable fact that the highest average annual temperature over extensive land areas occurs along or near the Equator. He is surprised, therefore, when he learns that, in general, the highest temperature of the ocean at every depth, save near the surface, is at 30°, roughly, north and south of the Equator. As the surface is approached from a depth of around 400 meters these maxima rapidly draw closer together, but do not merge even at the surface.

At every depth from 50 to 1,000 meters, or thereabouts, the equatorial water is approximately 5° C. colder than the warmest water at that level both north and south. As the depths become abysmal this contrast, though still present, is very slight, the temperature everywhere being of the order 1° to 3° C.

Most of these facts are shown graphically in Figure 1, a thermal cross section of the Atlantic Ocean at 30° W.[1]

Evidently this temperature distribution is owing essentially to the gradual sinking of water in the latitudes 15° to 40°, perhaps, north and south, and the slow upwelling of the ocean in the equatorial regions. This circulation in turn, however, seems to be the result of several factors:

1. Around latitudes 20° to 35° the skies are comparatively clear and evaporation in excess of precipitation.

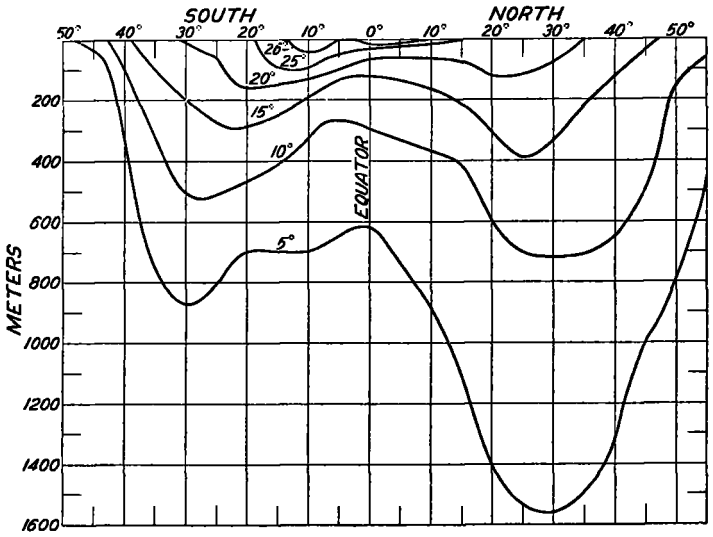

FIG. 1.—Temperature cross section of the Atlantic Ocean at longitude 30° W.

This increases salinity and, thereby, the density, which, of course, leads to sinking.

[1] Adapted from Tafel 28, Deutsche Tiefsee-Expedition, 1898-99, *Wiss. Ergeb.*, Band I, Atlas.

2. Near the Equator the sky is largely clouded and precipitation in excess, apparently, of evaporation, the excess coming from evaporation at higher latitudes. This leads to more or less dilution, decrease of density, and upwelling.

Both these causes, (1) and (2), are well known and generally accepted. There is a third factor, however, contributory to the result which I have not seen mentioned in this connection, namely:

3. The Ekman drift: As first shown by Ekman,[2] in the case of deep water far from land a steady wind produces a surface drift 45° to the right in the Northern Hemisphere, to the left in the Southern, of the direction of the wind with reference to the moving surface. But the velocity of the driving wind is thirty to thirty-five times that of this surface, hence the direction of the wind with reference to the water is substantially the same as its geographic direction. Furthermore, the total momentum of the moving water, mainly less than 50 meters deep, is at right angles to the direction of the wind with reference to the adjacent water. Therefore, since the equatorial winds generally are from the east, and the winds of higher latitudes than 35°, say, from the west, the momentum of the resulting Ekman drift is substantially poleward from low latitudes and equatorward from places beyond about 30° north and south. This force evidently tends to pile up the surface water along the belts between the oppositely-directed winds and therefore is a contributing cause of the continuous sinking of the water in these regions and its equally continuous upwelling along the equatorial belt.

Finally, since on the whole the surface temperature decreases from the Equator toward either pole, while the surface sinking covers rather wide belts centered roughly along latitudes 30° north and south, it follows that, for a considerable distance down, the belts of maximum temperature must recede from the Equator with increase of depth, as shown in the figure.

The surprising distribution of ocean temperature described above is, therefore, for the most part, an interesting meteorological effect.

[2] *Arkiv för Mat. Astr. och Fysik*, 1905.

EFFECT OF LOCAL SMOKE ON VISIBILITY AND SOLAR RADIATION INTENSITIES

By IRVING F. HAND,

[Weather Bureau, Washington, D. C., April 22, 1925]

The dense smoke cloud which covered the northwest section of Washington on the morning of April 7, 1925, was remarkable in so many respects that it is thought worthy of a brief description.

On that date the sun rose in a cloud-free sky with prospects for an excellent day for obtaining solar radiation observations. Heavy frost, a minimum temperature of 32° F., and ice one-half inch in thickness were recorded.

When pyrheliometric readings were first made at 6:40 a. m. the Blue Ridge was plainly visible 50 miles to the WSW. At that time little attention was paid to the rather streaked layer of smoke which overhung the business section of the city, as such layers are of somewhat frequent occurrence. However, this one was rather unusual in that its top was perfectly flat.

Half an hour later it became apparent that the solar radiation observatory, which is located on the American University campus, 5 miles NW. of the Capitol, would soon become enveloped in a smoke cloud. Coincident with the arrival of this cloud at 7:30 a. m., the visibility diminished until at 8 o'clock, the time of maximum covering, it had decreased from 50 miles to three-quarters of a mile.

Observations of the number of dust particles per cm.^{3} taken at 8 a. m. and at noon give values of 7,077 and 166, respectively. This former value exceeds by 17 per cent the previous Washington maximum, obtained at the Central Office of the Weather Bureau in January, 1924, while it is nearly three times the previous maximum obtained at the American University. It is approximately the number obtained in the Loop District of Chicago on a moderately smoky day—a statement which means much to anyone familiar with that city. The noon value, 166, is below the yearly average of all observations, and about the mean value obtained with a visibility of 30 miles, which was that noted at the time.

An examination as to the character of the dust particles showed that the first record obtained was composed almost entirely of soot, unconsumed carbon, and other products of combustion; many tiny glassy spheres with an average diameter of about 0.0008 mm. being included in the latter. The particles on the noon record were not only smaller but showed almost no soot.

TABLE 1.—*Distribution of meteorological elements*

Time	Temperature	Relative humidity	Vapor pressure	Visibility	Wind		Clouds, amount and kind
					Velocity	Direction	
	°F.	Per cent	Inches	Miles			
6 a. m.	32	87		50	1	NW.	0
8 a. m.	38	83	0.187	¾	2	SW.	0
Noon	57	20	0.089	30	7	S.	1 Ci.

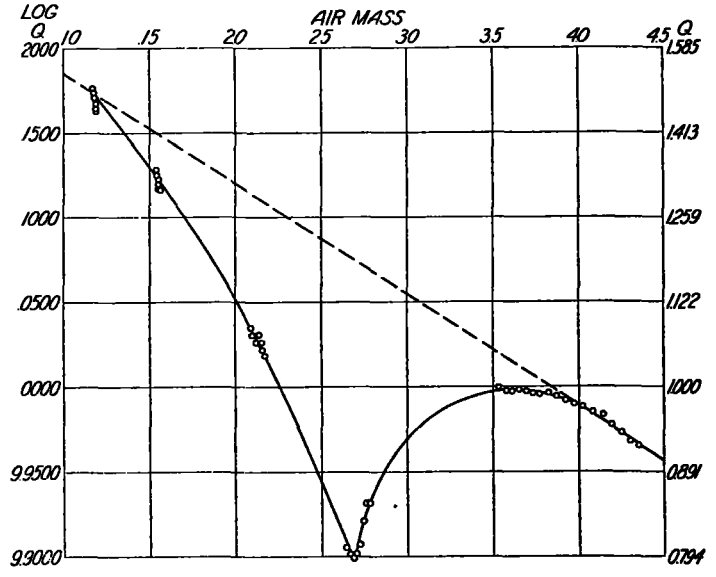

FIG. 1.—Solar radition intensities, American University, D. C., April 7, 1925, showing the effect of local smoke

As will be seen from Table 1, the visibility at noon was but 30 miles as compared with 50 during the early morning, but this is due, in part at least, to greater diffusion of light with increased altitude of the sun and to a background of clouds west of the Blue Ridge.